Remarks/Arguments:

Pending Claims

Claims 1-16 are pending. Claims 17-29 have been canceled.

Claim 8 was objected to as being dependent on a rejected claim. Applicants appreciate the Examiner's statement on page 7 of the Office Action that claim 8 would be allowable if rewritten in independent form. Claim 8 has been amended to be rewritten in independent form. Therefore, applicants respectfully submit that claim 8 is no longer subject to this objection.

Claims 1-6, 10, 13, 14, and 16 have been rejected under 35 U.S.C. § 102(b) as being anticipated by Altukhov et al. (Toward $Si_{1-x}Ge_x$ Quantum-Well Resonant-State Terahertz Laser). Claims 11 and 12 have been rejected under 35 U.S.C. § 103(a) as being anticipated by Altukhov et al. Applicants respectfully submit that claims 1-6, 10-14, and 16, as amended, are not subject to these rejections for the reason set forth below.

Altukhov et al. disclose a terahertz (THz) wave laser based on strained $Si_{1-x}Ge_x$ structures formed in thin layers with dimensions indicative of quantum-well structures. (Page 3909, last paragraph.) These layers are doped with boron. Although Altukhov et al. describe these structures as quantum-well structures, the states being utilized to achieve THz lasing are not the quantum-well sub-band states, but rather are resonant states of the acceptor levels, which are split by the strain induced by lattice mismatch between the layers. (Page 3909, fourth paragraph.) However, the thin heterogenous layers of the structure disclosed by Altukhov et al. are necessary to their device because the states used are formed by lattice mismatch strain, which decreases rapidly with distance from the interface at which the lattice mismatch occurs.

Claim 1, as amended, recites at least one feature that is not disclosed or suggested by Altukhov et al., namely:

> ...a bulk optical gain material formed substantially of at least one group IV element and doped with at least one dopant having an intra-center transition frequency in a range of about 0.3THz to 30THz;... (Emphasis Added)

Altukhov et al. do not teach or suggest that intra-center transitions of a dopant in the bulk optical gain material may be used to generate THz wave radiation. Instead, they teach the use resonant states of acceptor levels in thin strained layers of $Si_{1-x}Ge_x$ to generate THz wave radiation. Because the resonant states recited by Altukhov et al. require lattice mismatch strain that does not exist in bulk materials one skilled in the art would not understand Altukhov et al. to teach or suggest the use of bulk optical gain material.

In view of this deficiency, Applicant respectfully submit that claim 1, as amended, is not subject to rejection under 35 U.S.C. § 102(b) as anticipated by Altukhov et al., nor is claim 1 subject to rejection under 35 U.S.C. § 103(a) as unpatentable over Altukhov et al. As claims 1-6, 10-14, and 16 depend from claim 1, these claims are not subject to these rejections as well.

Claims 1 and 7 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Pavlov et al. (Stimulated Emission from Donor-Transitions in Silicon, Pavlov I) in view of Altukhov et al. Applicants respectfully submit that claims 1 and 7, as amended, are not subject to this rejection for the reason set forth below.

Pavlov I discloses an optically-pumped THz wave emitter. This THz emitter uses a CO_2 laser to create an intra-center population inversion in phosphorus-doped silicon. However, as stated by the Examiner on page 5 of the Office Action, Pavlov I does not teach, or suggest, that this population inversion via electrical pumping.

The Examiner argues that Altukhov et al. teaches electrically pumping an similar optical gain medium and that it, therefore, would have been obvious to one skilled in the art to modify the THz emitter of Pavlov I to be electrically pumped based on Altukhov et al.

Applicant respectfully disagree. As described above, the strained multilayer $Si_{1-x}Ge_x$ optical gain material disclosed by Altukhov et al. is significantly different that the bulk optical gain material recited in claim 1, as amended, of the present application. Further, Altukhov et al. do not disclose or suggest the use of intra-center transitions to generate THz wave radiation, but rather Altukhov et al. disclose using resonant states of acceptor levels in thin strained layers of $Si_{1-x}Ge_x$ to generate THz wave radiation.

Because of these differences in the optical gain material and the radiation mechanism disclosed by Altukhov et al. and those disclosed in Pavlov I, one skilled in the art would not have considered it obvious to try electrically pumping the THz emitter of Pavlov I based on the disclosure by Altukhov et al.

In view of this deficiency, Applicant respectfully submit that claim 1, as amended, is not subject to rejection under 35 U.S.C. § 103(a) as unpatentable over Pavlov I in view of Altukhov et al. As claim 7 depends from claim 1, this claim is not subject to this rejection as well.

Claims 1 and 9 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Pavlov et al. (Optically Pumped Silicon Terahertz Lasers, Pavlov II) in view of Altukhov et al. Applicants respectfully submit that claims 1 and 9, as amended, are not subject to this rejection for the reason set forth below.

Pavlov II disclose an optically-pumped THz wave laser based on the same optical gain material and radiation mechanism as Pavlov I. Thus, as described above, one skilled in the art would not have considered it obvious to try electrically pumping the THz laser of Pavlov II based on the disclosure by Altukhov et al.

In view of this deficiency, Applicant respectfully submit that claim 1, as amended, is not subject to rejection under 35 U.S.C. § 103(a) as unpatentable over Pavlov II in view of Altukhov et al. As claim 9 depends from claim 1, this claim is not subject to this rejection as well.

Claim 15 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Altukhov et al. in view of Soref et al. (US 6,154,475). Applicants respectfully submit that claim 15 is not subject to this rejection for the reason set forth below.

Soref et al. disclose a THz wave laser based on strained SiGe structures formed in thin layers similar to the $Si_{1-x}Ge_x$ structures disclosed by Altukhov et al.

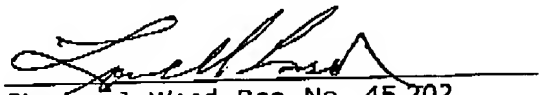
Like Altukhov et al., Soref et al. do not teach or suggest the use of intra-center transitions of a dopant in the bulk optical gain material material to generate THz wave radiation. Thus, Soref et al. cannot make up for the deficiencies of Altukhov et al. that are described above with respect to claim 1 of the present application, as amended.

Therefore, Applicant respectfully submit that claim 1, as amended, is not subject to rejection under 35 U.S.C. § 103(a) as unpatentable over Altukhov et al. in view of Soref et al. As claim 15 depends from claim 1, this claim is not subject to this rejection as well.

Conclusion

In view of the foregoing amendments and remarks, Applicants request that the Examiner reconsider and withdraw the rejections and objections of claims 1-16.

Respectfully submitted,



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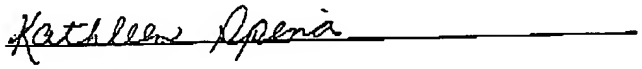

Kathleen Spina